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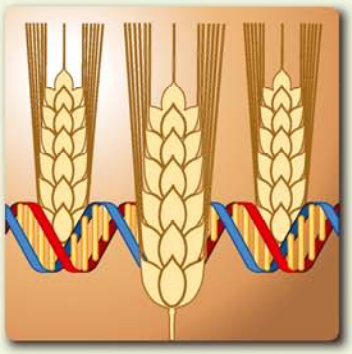

Contents

High quality mutant rice varieties widely grown in Viet Nam, TC project VIE/5/014 (for details please refer to TC Project Highlights)

To Our Readers

The most important event of these last six months is not difficult to spot: the change at the helm of the Joint FAO/IAEA Programme.

Jim Dargie retired at the end of July as Director of the Joint FAO/IAEA Programme. Jim was firstly a Technical Officer and later the Head of the Animal Production and Health Section before taking the position as Director of the Division more than 10 years ago. Under his guidance and leadership the Division has made significant progress forward in addressing the needs of Member States. Jim was also the focal point for Biotechnology at FAO and IAEA. His expert advice and guidance will be missed and will be hard to compensate. We want to wish him and his family luck and success in their future endeavours; because for a dynamic person such as Jim, retirement is synonymous with intense activities.

The newly appointed Director, as of 1 August 2005, is Qu Liang from the People's Republic of China. Liang, as he likes to be addressed, holds an advanced degree in Agronomy from the Chinese Academy of Agricultural Sciences. His former positions include Deputy Director General of the Institute for Application of Atomic Energy, Beijing; Director General of the Department of International Cooperation and Indus-

IAEA International Atomic Energy Agency

trial Development of the Chinese Academy of Agricultural Sciences; Permanent Representative of People's Republic of China to FAO, WFP as well as IFAD and, his most recent position, Director General, Dept. of International Cooperation in the Chinese Academy of Agricultural Sciences. Liang is not only very knowledgeable in plant breeding but also in mutation induction. We pledge to serve and support him faithfully as a team, for the greater benefit of our Member States.

Another focus of our activities this semester is on reporting for the last biennium 2004–2005. This exercise is very beneficial, as it allows us to critically appraise our activities for the Member States, to feel good about our success stories, but most important of all, to spot weaknesses and to develop strategies and action plans to improve ourselves. We appreciate your input in this respect, and wish to express here our gratitude for the innumerable input we receive from you.

The Mutant Variety Database (MVD) is nearing the 2500th accession. I wish to encourage you to use the form at the end of our newsletter to submit your officially released mutant variety. The 2500th mutant variety submitted to MVD will be especially celebrated. A special certificate will be issued to the breeder. This certificate will be officially presented to the invited breeder here in Vienna, Austria, at the IAEA Headquarters, the Vienna International Center (VIC). More information on this future opportunity to celebrate will follow in the next Newsletter.

I take this opportunity to congratulate our Vietnamese counterpart Dr. Thinh Do Khac (VIE/5/014) for receiving the National Prize of Science and Technology of Viet Nam on 30 September 2005, awarded every five years, for his salt tolerant mutant rice variety VND 95-20, the key vari- ety for export now, which made a "significant socio-economic contribution" to Viet Nam (see also TC Project Highlights).

IAEA Receives Nobel Peace Prize 2005

As many of you know, on 7 October 2005, it was announced that the Norwegian Nobel Committee awarded the Nobel Peace Prize for 2005 to the International Atomic Energy Agency (IAEA) and to its Director General, Mohamed ElBaradei, for their work for a safer and more peaceful world. The Committee commended our Director General and all the staff "for their efforts to prevent nuclear energy from being used for military purposes and to ensure that nuclear energy for peaceful purposes is used in the safest possible way". The Award Ceremonies took place in Oslo, Norway on 10 December 2005 at the Oslo City Hall.

I have the pleasure to announce that our colleague Rownak Afza (PBU) was designated to represent the Department of Nuclear Sciences and Applications at the Nobel ceremony. We are all very proud that the IAEA received this distinctive award, and that a deserving plant biotechnologist was chosen from amongst all our excellent and meritorious colleagues in the different fields of nuclear sciences and applications to represent the department.

In closing, I would like to take the liberty to wish all of you a peaceful turning of the year and the very best for the future.

Pierre J.L. Lagoda

Staff

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Forthcoming Events

IAEA/RCA Expert Consultation and Project Progress Review Meeting on "Mutant Multi-location Trials and Mutation Enhancement of Genetic Diversity" RAS/5/040, Jakarta, Indonesia, 13–18 March 2006

Technical Officer: Q.Y. Shu

The project was first approved in 2002 and is further extended to 2006. This project comprises two components: the establishment and implementation of mutant multi-location trials in the participating countries, and the establishment of an MGN for crop improvement, materials and information exchange in the region. A significant number of crop mutant varieties have been officially released in the region, bringing positive economical impact to the region. Mutation techniques are considered as the most direct and economical approaches to developing new variety from well-adapted, locally accepted germplasm of various crops. An agreement of exchange of seed material has been achieved among participants of the project.

The objectives of this Meeting are to

1. report results of various activities (germplasm enhancement and RMMT) made in 2005 under this project;
2. review and evaluate the achievements made in the past three years;
3. consult and discuss with invited experts and improve work plan for 2006;
4. together with the invited experts, jointly outline a draft book of Mutation Breeding in Asia with defined scopes and chapters.

Second Research Coordination Meeting on "Pyramiding of Mutated Genes contributing to Crop Quality and Resistance to Stress Affecting Quality", Nanjing, China, P.R., 10–14 April 2006

Technical Officer: Q.Y. Shu

17 participants from 16 countries/international organizations countries (Australia, Bulgaria, China, P.R., Cuba, France, India, Indonesia, Iran, Japan, Republic of Korea, Macedonia, Pakistan, Poland, Thailand, United Kingdom, and (CIAT) Colombia are working on this Coordinated Research Project (CRP). It is aimed to improve various quality characters of eight crops using mutation and molecular marker techniques. The quality traits to be tackled include characters related to consumer preference, nutritional quality, processing quality, and tolerance to stresses affecting quality of barley, cotton, groundnut, okra, potato, rice, sorghum, and wheat. Both mutation and conventional germplasm will be used for identification of genes contributing to above quality and quality related characters. Desirable genes will be pyramided into elite breeding lines using molecular marker techniques.

In the second RCM, all participants will be invited to report the progress made and collaborations established in research since the first RCM. The up-to-date relevant new technologies will be reviewed and discussed with regard to their applicability and possible inclusion in individual research projects. Individual and group workplans will be discussed and agreed upon for the coming years, and collaborative links are expected to be enhanced.

Sixth Interregional Training Course on "Mutant Germplasm Characterization using Molecular Markers", Seibersdorf, Austria, 15 May–16 June 2006

Technical Officer: C. Mba

The sixth FAO/IAEA Interregional Training Course is scheduled for 15 May to 16 June 2006 and will have 20 participants from developing Member States in attendance. As usual, it shall be held at the Plant Breeding Unit, FAO/IAEA Agriculture and Biotechnology Laboratory, Agency's Laboratories, Seibersdorf, Austria. The course will entail lectures and practical laboratory exercises covering the theory and use of DNA markers, with particular emphasis on their applications in plant breeding and in the characterization of crop mutants. The course will include substantial hands-on training and the topics covered will include:

1. Radioactive labelling and detection of DNA fragments;
2. High throughput detection of mutated genome segments;
3. Induced mutants as functional genomics resource;
4. Commonly used DNA marker techniques (AFLP, SSR, ISSR, IRAP, etc.);
5. Cytogenetic techniques (including chromosomal analysis using fluorescence in situ hybridisation);
6. Applications of DNA markers (marker-assisted selection, molecular genetic fingerprinting, linkage analysis and genetic mapping principles);
7. Computer based exercises (genetic mapping, genetic diversity and phylogenetic analyses, DNA sequence analyses and bioinformatics).

The receipt of nominations on standard Agency forms (downloadable from http://www-

tc.iaea.org/tcweb/participation/astrainee/default.asp) is open until 15 January 2006. The five-week training course is funded by FAO and IAEA and will be provided free of charge. The travel costs, living expenses and accommodation of the participants will be borne by the FAO/IAEA Joint Programme.

Further information can be obtained from Chikelu Mba (Course Director) c.mba@iaea.org

Past Events

First Research Coordination Meeting on "Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava", Vienna, Austria, 11–15 July 2005

Technical Officer: C. Mba

Seventeen participants from 13 Member States (Bangladesh, Brazil, China, P.R., Cuba, Czech Republic, Ghana, India, Indonesia, Kenya, Mexico, Nigeria, the Philippines and United Kingdom) and two international organizations (International Centre for Tropical Agriculture – CIAT, Cali, Colombia and the International Network for the Improvement of Banana and Plantain – INIBAP, Montpellier, France) and staff of the Joint FAO/IAEA Programme met in Vienna for five days in order to agree on deliverables and fine-tune the work plan of the institutes collaborating in this CRP.

This CRP was conceptualized out of the need to address the dearth of technologies for addressing the peculiarities associated with the genetic improvement of vegetatively propagated crops (as against seed propagated crops), especially the lack of uniform genetic backgrounds in starting materials. Using the genetic improvement of bananas and cassava as references, this CRP seeks to develop and deploy methodologies for the integration of molecular and *in vitro* techniques in the use of induced mutations for developing superior varieties of these two crops with enhanced quality attributes. This is predicated on the knowledge that new powerful neutral tools of molecular biology that can circumvent the confounding effects of non-heritable factors while evaluating crop germplasm can, when applied in concert with induced mutations (deliberate artificial change to the genetic make up of individuals) and cell culture techniques, facilitate the improvement of these crops. This CRP will build upon the existing molecular resources and information on the genetic make up of banana and cassava (e.g. genomics tools) and bring them to bear upon efforts to produce improved varieties of both crops.

The main strategy will involve the development of exhaustively characterized populations structured for the discovery of genes influencing traits of interest while capitalising on the experiences of the Agency in the use of induced mutations for the genetic improvement in both crops. This CRP will also facilitate access to information resources on the genetic make up of these two crops currently being held by advanced labs, and the development of plant populations that make genetic improvement easier and facilitate the location of the genes controlling traits of interest. The above tools will be applied to improve the efficiency of enhancing quality traits, and the equally important tolerance to biotic and abiotic stress constraints in banana and cassava in active cassava and banana breeding programs in Member States.

The participants of the RCM agreed on the model genotypes of the two crops for use in the assays; the traits of interest; the available resources (especially genomics tools); available technologies; and uniform methodologies for carrying out the assays. Major outputs from this RCM also included the identification of constraints and suggested mechanisms for mitigating them. For banana, the absence of mapping populations was considered critical and deserving of addressing through a Technical Contract (TC) under the auspices of this CRP. For the crop also, there is no access to ESTs without Intellectual Property Rights (IPR) constraints and INIBAP was mandated to explore mechanisms for solving this problem. The lack of efficient protocols for the production of double haploids, necessary for the generation of homozygous materials for mutation induction and other genetic assays are lacking for the two crops. Three participants shall be addressing this for banana while the award of a TC was recommended for cassava. Scientists at the Austrian Research Centre were recognized as potential partners for providing assistance in high throughput genotyping through a microarray platform. In the same vein, the acquisition of a TIILING facility by the Joint FAO/IAEA Programme was recognized as an interim solution for the use of this technology in high throughput identification of mutation events in the course of the CRP. In recognition of the possibility that IPR issues may militate against exchange of genomics and genetic resources, the Joint FAO/IAEA programme was requested to explore possibilities for addressing this through MoU's. Time frames for the deliverables were also agreed upon and India was chosen as the venue for the next RCM sometime in late 2006 to early 2007.

Fifth Interregional Training Course on "Mutant Germplasm Characterization Using Molecular Markers", Seibersdorf, Austria, 1–26 August 2005

Technical Officer: C. Mba

The fifth edition of this course was held from 1–16 August 2005 at the Agency's laboratories in Seibersdorf. The 20 participants were drawn from Angola, Brazil, Chile, China, P.R., Costa Rica, Cuba, Ethiopia, Ghana, Indonesia, Malaysia, Nigeria, Pakistan, Romania, Slovenia, Sri Lanka, Syria, Tanzania, Thailand, Uganda and Viet Nam. The lectures and exercises were delivered by an international panel of well-renowned Scientists from Finland, France, Israel, United Kingdom and United States of America and Agency Staff Members. The modules covered theoretical and hands-on experience in induced mutations; high throughput detection of mutation events; and the application of commonly used molecular genetic and cytogenetic markers for crop germplasm evaluation and genetic studies. The course participants were also exposed to the use of standard population genetics analytical tools for molecular genetic data management.

We are currently receiving applications for the sixth edition of the course scheduled for 15 May to 16 June in Seibersdorf and Vienna, Austria.

Second Research Coordination Meeting on "Physical Mapping Technologies for the Identification and Characterization of Mutated Genes Contributing to Crop Quality", Reykjavik, Iceland, 22–26 August 2005

Technical Officer: M. Miranda

Mutation induction technology is able to address the need for improving quality traits in crops, especially in crops grown by small farmers that are adapted to local environmental conditions and contribute to food security, health and agricultural sustainability. Quality products give the farmer a competitive market advantage and high added value, which will result in increased farm income. Public health is improved by access to a better quality diet that prevents malnutrition and nutrient deficiency. Physical and molecular mapping can provide the scientific basis for the establishment of an effective approach to manipulate and characterize various quality characters, including the transfer of genes between varieties and species.

This Coordinated Research Project (CRP) addresses the problems of application of advanced molecular and mutation technologies for crop improvement, and aims to accelerate the improvement of quality traits through the use of physical mapping and complementary genomic technologies for the characterization of natural diversity and induced mutants. The availability of complementary targeted mapping strategies, high resolution linkage maps and comparative mapping tools in combination with crop genetic resources allows for efficient utilization of genes for crop improvement. Moreover, information about evolutionary relatedness between wild and cultivated germplasm is necessary for the introgression of new genes for value added traits into cultivated species. It is estimated that world food production has to increase approximately 66% in the next 35 years in order to keep up with population increase from six billion to about nine billion people. The first UN Millennium Development Goal is to reduce the number of people who suffer from hunger by 50% between 1990 and 2015. The application of the genetic and physical mapping technologies, such as those developed by this CRP, can contribute to achieve this goal.

In this CRP, the following characters have defined 'crop quality': nutritional (amino acid and protein, beta-carotene, lycopene, fatty acid composition), organoleptic (aroma, flavour, color), processing (preservation, gelatinization temperature), fiber quality (length, strength), abiotic stress-related (salinity, drought, cold, acidity) and reproductive sterility. Molecular cytogenetic markers associated with these value added traits are being developed and used for the identification of chromosomes and genomes, as well as to link physical and genetic maps. In addition, molecular markers including SSR, ISSR, IRAP,

EST, RFLP, AFLP are being utilized for genotyping and DNA fingerprinting of mutant lines and germplasm. These technologies are being applied for physical and genetic mapping of quinoa, lymegrass, tomato, chili pepper, sweet pepper, rice, wheat, beet and cotton, and may be transferred to many other seed and vegetatively propagated crops.

13 participants from Argentina, Bulgaria, China, P.R., Czech Republic, Germany, Iceland, Pakistan, Poland, United Kingdom, United States and Viet Nam gathered at the second RCM to discuss the progress made during the first three years of the CRP. The RCM was marked by excellent reports and, among the highlights, advanced sweet-pepper mutants with high β-carotene contents and fine-mapping of the aluminium resistance in rye have full potential for becoming success stories in the near future. The third RCM is planned to take place in 2007 in Argentina.

Opening Ceremony of IAEA Collaborating Center at Zhejiang University, Hangzhou, China, P.R., 13–18 October 2005

Liaison Officer: P.J.L. Lagoda

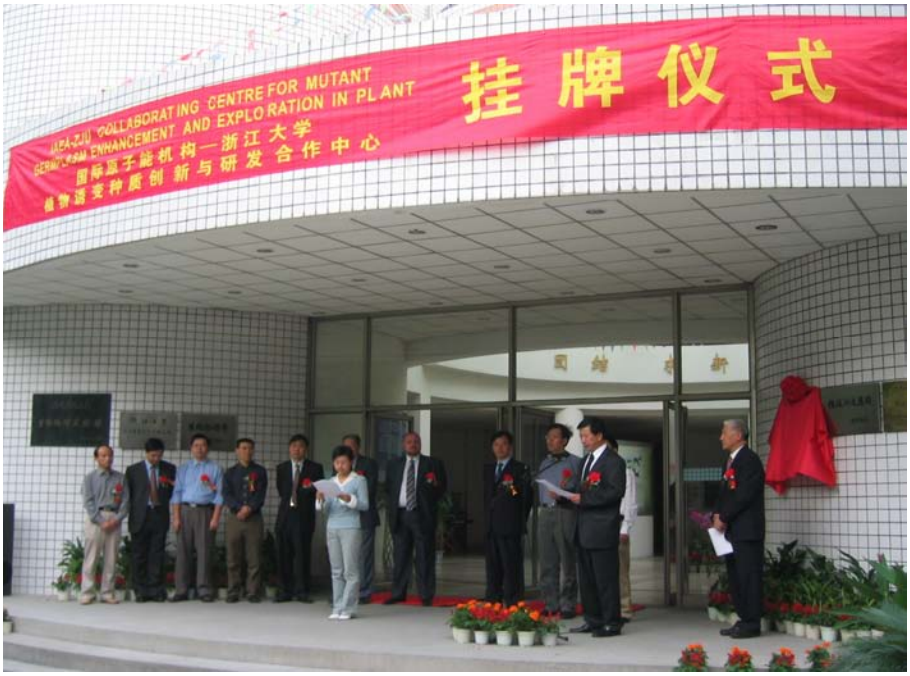
The concept of a distinguished and internationally recognized scientific institute being a Collaborating Centre is well established with such organizations as the World Health Organization, and with the Food and Agriculture Organization of the United Nations. The Agency recognized the success of their Collaborating Centres, and the Director General has agreed that IAEA may operate a similar scheme on a trial basis. Ten Centres worldwide were selected, and Zhejiang University is the very first IAEA Collaborating Centre to be designated.

The Agency has had excellent links with the Institute of Nuclear Agricultural Sciences since the late 1980's. It has been the counterpart of eight national and regional Agency technical cooperation projects, and has also participated in several Agency sponsored research projects.

The first regional training course in People's Republic of China on plant mutation breeding was co-organized as long ago as 1986, and the institute has become a frequent host for individual fellowship training and workshops. This new relationship as an IAEA Collaborating Centre is bound to strengthen even further the scientific benefits to both organizations.

A three year plan has jointly been developed to enhance our collaboration in the field of Mutant Germplasm and Exploration in Plants. Among other tasks, the Institute will work with others in People's Republic of China to collect information on the progress of mutation techniques, and will work with the Agency in developing new technologies and research in rice plant mutation breeding, and for crop improvements.

This work is vital in helping to provide more essential food, not only in People's Republic of China but worldwide. Through such collaboration with advanced technology centres, the Agency is committed to working with others to implement the United Nations Millennium Development Goals, using nuclear technologies where these bring unique advantages. This work is in the areas of water resource management, in human health, on marine and terrestrial studies for a cleaner and safer environment, in chemical sciences to help industries, and of course, in food and agriculture, which is the Agency's largest programme jointly with the Food and Agricultural Organization. The Agency and FAO recently celebrated 40 years of successful cooperation through their Joint FAO/IAEA Programme in Vienna. This partnership is bound to become a model for others to follow. With the



Creation of the IAEA Collaborating Centre scheme, the Agency aims to strengthen and better promote the values of nuclear technologies for producing food for a hungry world.

The designation ceremony was a success, and the importance of this event was acknowledged by all local, regional and national officials attending the ceremony, who highlighted the importance of this event for nuclear technology enhanced agriculture in People's Republic of China. The local and regional representatives stressed their appreciation for the Agency acknowledging their expertise in the field of applied nuclear technologies and achievements: they feel strengthened on the national level by this international recognition. In this respect it is worthwhile to point out the triple distinction conveyed to Zhejiang University by this designation, namely being one of only ten Collaborating Centres worldwide, being the first amongst all possible distinguished and internationally recognized scientific institutions to be chosen as Collaborating Centre for IAEA, and a special distinction for Chinese agricultural sciences as its Institute of Nuclear Agricultural Sciences harboring this first IAEA Collaborating Centre.

Second Coordination Meeting for RAF/5/050 "Increasing Production of Nutritious Food through Mutation Breeding and Biotechnology" (AFRA III-3), Nairobi, Kenya, 24–28 October 2005

Technical Officers: M. Spencer and Q.Y. Shu

National coordinators of the participating countries of this regional project e.g. Algeria, Cameroon, Egypt, Ethiopia, Ghana, Kenya (Host Country), Libyan Arab Jamahiriya, Madagascar, Mali, Mauritius, Morocco, Níger, Senegal, Sierra Leone, South Africa, Sudan, Tunisia, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe were invited to the meeting.

The objectives of this regional project is to assist AFRA Member States in the development and field evaluation of improved crops for higher agricultural productivity, better nutrition, and greater tolerance to stress. Based on the progress reports presented by the participants, significant progress has been made since meeting in 2003 towards capacity building, technology development and application of mutation induction in crop production.

On field evaluation in Madagascar – TC project RAF/5/050

New mutation induced varieties of sesame, wheat, banana and finger millet varieties have been officially released, and some of them are already been widely grown, and several other promising lines are in the pipeline or ready for release, e.g. double haploid wheat, safflower, barley, Lucerne, lentil, wheat, durum wheat, rice and beans.

Individual and group work plans were discussed and agreed upon for 2006. Two training courses will be organized to further help the Member States in enhancing their capacity in general and implementing the project in particular. The project is expected to be extended to a new phase (2007–2011), and a draft of the project concept and work plan, with emphasis on market oriented crops was also developed during the meeting

The participants acknowledged their appreciation of the contribution made by the local organizer, the National Plant Breeding Research Centre (NPBRC), Kenya Agricultural Research Institute (KARI) and especially to the Director of the NPBRC; Dr. Miriam Kinyua and her staff.

Second Research Coordination Meeting on "Effects of Mutagenic Agents on the DNA Sequence in Plants", Seoul, Republic of Korea, 14–18 November 2005

Technical Officer: P.J.L. Lagoda

The second RCM of this ambitious CRP was held at the Seoul National University, College of Agriculture and Life Sciences, School of Plant Science at South Korea. Ten contract holders (Bulgaria, China, P.R., Colombia, India, Republic of Korea, the Phillipines, Poland, South Africa) and three agreement holders (United States of America, United Kingdom), working on banana, barley, brassica, cassava, cowpea, wheat, rice, soybean and tomato, attended this very fruitful steering meeting of the CRP.

Modern plant breeders and farmers can exploit a wealth of natural biodiversity, which may be widely broadened through the application of mutation induction techniques. The impact of induced mutation on crop improvement is reflected in the more than 2350 officially registered varieties (IAEA's database on officially registered mutant varieties, MVD) carrying novel induced variation. Moreover about three-quarters of these are direct mutant varieties derived from treatment with gamma rays, thus highlighting the importance of physical mutagens. All this translates into a tremendous economic impact on agriculture and food production that is currently valued in billions of dollars and millions of cultivated hectares. However, while the agronomic potential of induced mutation is well understood, the precise effects of different mutagenic agents on the DNA sequence in plants have never been described. Furthermore, in recent years novel reverse genetics and gene discovery technologies have spurred renewed interest in induced mutation. For these new applications it is necessary to understand more clearly the types of mutations generated by the different classes of mutagens, and to measure their frequency and distribution along the genome. Today, and for the first time, the technologies are in place to undertake the experiments necessary to gain this understanding.

Mutagenic agents can be classified into three categories: physical (e.g. gamma rays), chemical (e.g. ethyl methane sulphonate) and transposable elements (such as transposons, retrotransposons, T-DNA, retroviruses). At present, limited data are available on the scope of genetic effects induced at the molecular level in plants and on the specificity and relative efficiency of these different categories of agents. These effects involve DNA damage, which results in base pair changes (single/simple nucleotide polymorphisms, SNPs), small insertions and deletions (indels) and chromosomal rearrangements. Even less is known about how induced mutation interact with epigenetic processes, such as methylation, activation of retro-elements, and perturbation of higher order DNA structure.

While breeders have been using mutation induction to broaden the genetic base of germplasm, and have used the mutant lines directly as new varieties or as sources of new variation in cross-breeding programmes, knowledge of the precise nature of the induced mutations was not necessary. Intuitively a conservative level of small base pair rearrangement and deletion was considered to be ideal. Nowadays, the use of mutation techniques has expanded beyond applications in breeding to gene discovery and reverse genetics. These new high-throughput applications require specific classes of mutations that are induced with high efficiency over entire crop plant genomes, and consequently knowledge of the precise nature of induced mutation is becoming an issue.

High-throughput gene discovery methods depend heavily on insertional 'knockout' lines, the now classical 'gene machines', and deletion 'knockout' libraries. Insertional mutagenesis involves inducing increased activity of transposition of known transposable elements (e.g. retrotransposons which tend to transpose into active genes) to produce series of lines in which, in theory, every gene in the genome will have been inactivated by the transposon insertion. These lines can be used to identify genes that cause particular phenotypes or, conversely, can be used to identify gene function by searching for a phenotype associated with the inactivation of a particular known gene. However, insertional mutants have a tendency to be unstable (e.g. excision of the transposon tag, e.g. Ac/Ds binary system, in the next generation might cause the phenotype to revert to the original parent type, or activation of retrotransposon tags through different stresses might multiply insertion events, e.g. during micropropagation). In comparison to insertional mutagenesis, conventional mutation induction (e.g. using physical or chemical agents) provides the advantage of stable mutations.

In theory, the production of deletion libraries involves inducing moderately large deletions, ideally spanning 1

kb to 100 kb in size, in each of a series of lines. These deletions should encompass segments of every gene in the genetic repertoire and should be represented at least by one line in the deletion library. These deletion lines can, when used together with whole genome gene arrays, be used to identify genes responsible for particular phenotypes or to confirm the association of known genes with particular phenotypes.

A novel and important reverse genetics approach is 'targeting induced local lesions in genomes' (TILLING). Here, large numbers of small changes, either DNA base pair substitutions or small deletions spanning no more than a few base pairs, are induced in a series of lines. In these lines gene function can be ascertained by associating a phenotype with changes in a particular gene and novel alleles of known genes can be generated.

Over the coming years, new technologies such as these will have increasing impact in practical plant breeding. However, they will require different types of mutations induced at specific frequencies. In order to tailor the mutation process, there will be a need to understand how specific classes of mutations are generated and distributed over genomes. In the past, this has not been possible because of lack of analytical tools and an inadequate knowledge of both the process of DNA damage and the architecture of plant genomes. In addition, only a restricted number of plant genes were sequenced. Today, high-throughput DNA sequencing methods coupled with bioinformatics and functional genomic approaches provide extensive knowledge on genome architecture. The complete genomic DNA sequence of a model dicotyledonous plant, Arabidopsis, and a model monocotyledon, rice has become available recently. Also scientists find themselves now with an array of methods, mostly developed as molecular marker technologies that can be adapted to quantify changes in DNA sequence. All in all, the stage is set to transfer the science of DNA damage induced by physical and chemical mutagens from human genetics to plant systems. A range of technologies can now be used to quantify both the underlying base rate, over numbers of generations, of spontaneous mutation and the instantaneous effects of mutation agents. Thus scientists now finally find themselves in a position to undertake experiments that can unravel the sorts of mutations induced by different mutagens so that future users of induced mutation may use the technology in a fully informed manner.

This Coordinated Research Project aims to understand the mechanism of mutation induction in plants and to quantify the types (base pair changes or deletions), incidence (frequencies and rates of change relative to mutagen dose) and patterns (heterogeneities in the induction of changes in the genome) of mutation induced at the DNA level by a range of physical and chemical agents. Molecular marker, DNA array, and novel reverse genetic methodologies will be used in a unique approach to analyze and survey the induction of mutations elicited in a number of crop plant species of agronomic importance. These results will be used to provide protocols and guidelines important for plant biology.

Regional Training Course on Molecular Markers in the frame of RAS/7/014 "Monitoring of Food Fortification Programmes Using Nuclear Techniques", Bangkok, Thailand, 28 November–2 December 2005

Technical Officer: P.J.L. Lagoda

The regional Technical Cooperation Project RAS/7/014 aims to evaluate and monitor the food fortification intervention programmes in five participating Member States (China, P.R., Indonesia, Pakistan, Thailand and Viet Nam), and to develop rice mutants with low phytic acid from the country's high-yield rice varieties. Phytic acid has the ability to sequester iron and zinc, resulting in a reduction of their bioavailability. The reduction of phytic acid, conversely should increase iron and zinc bioavailability, thus reducing micronutrient malnutrition, the hidden hunger causing anaemia and threatening normal child development and young women's health.

This regional training course was envisaged to provide the counterparts with the basic tools for utilizing molecular techniques in their ongoing crop improvement programs. The introduction of modern molecular techniques for genotyping, such as microsatellites micro-arrays and TILLING, will support their programs and accelerate the selection of mutants containing low phytic acid.

Status of Coordinated Research Projects

Physical Mapping Technologies for the Identification and Characterization of Mutated Genes Contributing to Crop Quality

Technical Officer: M. Miranda

This CRP was initiated in 2002. The second RCM was held in Reykjavik, Iceland, 22-26 August 2005. The third RCM is planned to take place in Cordoba, Argentica in 2007.

(For details, please refer to PAST EVENTS)

Effects of Mutagenic Agents on the DNA Sequence in Plants

Technical Officer: P.J.L. Lagoda

This CRP was initiated in 2003. The first RCM was held in Vienna on 1–5 March 2004. The second RCM was held in Seoul, South Korea, 14–18 November 2005.

The third RCM is tentatively planned in April 2007.

(For details, please refer to PAST EVENTS)

Pyramiding of Mutated Genes Contributing to Crop Quality and Resistance to Stress Affecting Quality

Technical Officer: Q.Y. Shu

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria, 13–17 September 2004.

The second RCM is planned for 10–14 April 2006 in Nanjing, China, P.R.

(For details, please refer to FORTHCOMING EVENTS)

Identification and Pyramiding of Mutated Genes: Novel Approaches for Improving Crop Tolerance to Salinity and Drought

Technical Officer: M. Spencer

This CRP was initiated in 2004. The first RCM was held in Vienna, Austria, 14–18 March 2005.

The second RCM is planned for 6–10 November 2006 in Accra, Ghana.

(For details, please refer to PAST EVENTS)

Molecular Tools for Quality Improvement in Vegetatively Propagated Crops Including Banana and Cassava

Technical Officer: C. Mba

This CRP was initiated in 2004. The First RCM was held in Vienna, Austria, 18–22 July 2005.

The second RCM is tentatively planned for the end of 2006 or the beginning of 2007 in India.

(For details, please refer to PAST EVENTS)

Technical Cooperation Projects

Currently Active Projects

Project Number	Title	Technical Officer
COS/5/025	Development of Induced Mutations and Biotechnology for Improved Productivity and Competitiveness	C. Mba
GHA/5/031	Enhancing Cassava Production through Supplementary Nutrient Application	C. Mba
INS/5/030	Sustainable Agricultural Development in Yogyakarta	M. Spencer
INS/5/031	Mutation Breeding of Horticultural Crops	M. Spencer, M. Miranda
INT/5/147	Developing Salt-tolerant Crops for Sustainable Food and Feed Production in Saline Lands	M. Spencer, M. Miranda
IRQ/5/015	Induction of Mutations in Crops through *In Vitro* Culture	P.J.L. Lagoda
KEN/5/024	Crop Improvement and Management through Application of Nuclear and Biotechnology Techniques	Q.Y. Shu
MAL/5/024	*In Vitro* Mutagenesis for Horticultural Crop Plants (Phase I)	M. Spencer
MYA/0/007	Nuclear Science and Technology Training Centre (currently a Human Development Project)	P.J.L. Lagoda
MYA/5/010	Development of Improved Rice with Tolerance to Drought and Soil Salinity	Q.Y. Shu
NIR/5/031	Radiation-Induced Mutations for the Development of Cowpea Varieties	P.J.L. Lagoda
PAK/5/040	Improvement of Heat-Tolerant Semi-Dwarf Bread Wheat through Radiation Induced Mutations	P.J.L. Lagoda
PAK/5/042	Induced Mutation to Improve Salt-tolerance in Non-aromatic Rice Varieties	P.J.L. Lagoda
PAK/5/044	Improvement of Drought Tolerance in Chickpea through Induced Mutations	P.J.L. Lagoda
PER/5/024	Introduction of Barley and other Native Crop Mutant Cultivars	P.J.L. Lagoda
PER/5/028	Use of Nuclear Techniques to Improve Cotton Production	C. Mba
PHI/5/029	Enhancing Agricultural Productivity through Radiation Technology in Mindanao	M. Spencer
RAF/5/049	Field Evaluation of Bayoud-Resistant Date Palm Mutants	M. Spencer, P.J.L. Lagoda
RAF/5/050	Increasing Production of Nutritious Food through Mutation Breeding and Biotechnology (AFRA III-3)	Q.Y. Shu, M. Spencer
RAS/7/014	Monitoring of Food Fortification Programmes Using Nuclear Techniques	P.J.L. Lagoda
RAS/5/040	Enhancement of Genetic Diversity in Food, Pulses and Oil Crops and Establishement of Mutant Germplasm Netqork (RCA)	Q.Y. Shu
ROK/5/033	Quality Improvement of Major Crops and Integrated Plant Nutrition Management in the Low-Input Agricultural System	P.J.L. Lagoda
SAF/5/008	Mutant Amaranth, Bambara Groundnut and Cowpea with Enhanced Abiotic Stress Tolerance	Q.Y. Shu
SIL/5/007	Development of High-yielding Rice Varieties for Low-input Agriculture Systems using Mutation Techniques	Q.Y. Shu

Project Number	Title	Technical Officer
SRL/5/034	Radiation-Induced Mutations for Black Pepper Improvement	P.J.L. Lagoda
SRL/5/036	Virus Screening of Improved Banana Mutants for Large-Scale Dissemination	P.J.L. Lagoda
SUD/5/026	Improvement of the Productivity and Sustainability of Industrial Crops	Q.Y. Shu
TUN/5/023	Radiation-Induced Mutations for Improvement of Cactus	M. Miranda
TUR/5/023	Application of Nuclear and Gene-Based Biotechnology in Agriculture	P.J.L. Lagoda, M. Miranda
URT/5/023	Enhancing Crop Productivity through Radiation Technology	Q.Y. Shu
VIE/5/014	Rice Mutant Varieties for Saline Land	Q.Y. Shu
VIE/5/015	Enhancement of Quality and Yield of Rice Mutants using Nuclear and Related Techniques, Phase II	Q.Y. Shu
YEM/5/007	Use of Induced Mutations and *In Vitro* Culture for Improving Crops	P.J.L. Lagoda
ZAI/6/009	Mutation Techniques for Improving Medicinal Plants with a Curative Effect on Human Diseases	M. Miranda, M. Spencer
ZAM/5/022	Crop Improvement through *In Vitro* Mutation Technique	Q.Y. Shu

TC Project Highlights

Rice mutant varieties for Saline Land, Phase II (1994–2004) VIE/5/014

This project was aimed to further develop and extend improved mutant varieties and advanced mutant lines of rice in Viet Nam. Three counterpart institutes participated in this project, e.g. the Agricultural Genetics Institute in Hanoi; the Cuu Long Rice Research Institute in Cantho, and the Institute of Agricultural Sciences in Southern Viet Nam. Through out the project timeframe, a total of eight new high quality rice mutant varieties have been developed and adopted by farmers in Viet Nam, where rice export is one of their main revenues. Mutant rice variety VND99-3, registered as a national variety with quality for export, is of short duration (100 days), meaning three rice harvests per year in the Mekong Delta. Mutant rice variety VND95-20 with high quality and tolerance to salinity became the key rice variety for export in 2005; occupying 28% of the one million ha export rice area in the Mekong Delta. For the "significant socio-economic contribution" of this variety to Viet Nam, the local counterpart received the "National Prize of Science and Technology of Viet Nam". This is so far the first mutant variety being awarded the national highest prize in Viet Nam.

Ongoing Activities at the Plant Breeding Unit, Seibersdorf

Introduction

In the framework of the Agency's Subprogramme on Sustainable Intensification of Crop Production Systems, the Plant Breeding Unit (PBU) of the Agriculture and Biotechnology Laboratory (ABL), Agency Laboratories, Vienna and Seibersdorf, is working with plant breeders from Member States (MS) of FAO and the Agency in the use of induced mutations to develop better crop varieties. Such new variants have traits that mitigate critical production constraints to crops within the Member States. Over the years, these sub-program activities have boosted the impetus for the use of induced crop mutations in Member States resulting in crops with dramatic improvements in turn translating to billions of dollars in additional income to farmer in Member States where the technology has been enthusiastically adopted. Our Unit fits into this scheme through the provision of capacity building to scientists from Member States in the use of induced mutations facilitated by enabling biotechnologies; the provision of services; and the carrying out of research and development (R&D) activities aimed at developing or adapting technologies that have potentials for working within the milieu of the usually resource-challenged counterparts in Member States. In order that such technologies have the greatest chances for being successfully adopted in the Member States, we have strategically been using a 3-commodity crops platform, bananas, cassava and rice, for our R&D activities. Our ability to achieve success in these has been largely on account of the winning collaborations with our national counterparts, several centers of the Consultative Group on International Agricultural Research (CGIAR) and advanced laboratories.

The highlights of these activities and synergies have been exposed in previous editions of this newsletter. In the earlier edition this year, we presented the status of our ongoing activities in R&D; the provision of services; and in capacity building. We are presenting the current status and perspectives for 2006 in the following sections.

Commodity crops based platform for R&D

Rice

In furtherance to our continuing collaboration with the International Rice Research Institute (IRRI), Manila, Philippines that has resulted in the development of saline tolerant rice variants that have been integrated into breeding schemes in Asia, some of these mutants have been nominated for field-testing in sub-Saharan Africa. While the main target will remain saline tolerance, other traits of agronomic interest shall also be evaluated with the aim of integrating these into breeding schemes in Africa. A new collaboration has also been initiated with the International Centre for Tropical Agriculture (CIAT, its Spanish acronym), Cali, Colombia for the development of superior rice varieties for South America.

Cassava

In addition to the on-going efforts aimed at the development of efficient methodologies for induced mutations in cassava, we are now partnering with CIAT on one hand and the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria on the other in the development of cassava mutants with value added traits for sub-Saharan Africa and Latin America and the Caribbean, respectively.

Banana

Field evaluation of banana mutants is ongoing at Kenya Agriculture Research Institute (KARI) Njoro, Kenya and the Kawanda Agricultural Research Institute (KARI), Kampala, Uganda with the main objectives including the identification of disease tolerant variants. Molecular marker development and validation are also ongoing.

Future perspectives

In a bid to be more responsive to the region specific issues, we are in addition to the above ongoing initiatives embarking on the large scale development and field evaluation of banana and cassava mutants in Member States. Such exhaustively field characterized mutants will then be genotyped with the aid of our newly acquired facility for Targeting Induced Local Lesions in Genomes (TILLING). These will be done with the active participation of colleagues from the Musa Genomics Consortium in the case of banana; and CIAT and IITA for cassava. For rice, our TILLING activities will be in collaboration with IRRI and shall be building upon the resources already available at the Institute. It is expected that the outputs from these activities would in addition to superior mutant crops also lead to the development and deployment of publicly available reverse genetics resources for these crops.

Molecular genetic fingerprinting

Most of our activities in this regard have been dedicated to the use of our high throughput facility for in-house needs for DNA fragment sequencing and separation. About 1 300 samples were analysed in the past six months.

Irradiation services

The services provided by the Unit in support of activities in Member States for the period June to November 2005 are summarized below:

Number of requests	18
Number of species	19
Number of varieties	74
Number of treatments	249
Number of requesting Member States	10

Flow cytometry

Ploidy measurements of 360 anther cultured derived plants were carried out in order to ascertain the success of dipoidization, e.g. doubled haploidy.

Training and capacity building

Our ability to work with Member States is greatly enhanced through interactions with Scientists and policy makers from these countries. Our Unit therefore regularly plays host to national counterparts with collaborative endeavors usually arising from such meetings. The following were the Scientific Visitors during the period under review.

Visiting Scientists

Name	Country	Subject Area	Period
X.T. LE	Viet Nam	Induced mutagenesis for genetic improvement of rice	November 2005
V.V. NGUYEN	Viet Nam	Induced mutagenesis for genetic improvement of rice	November 2005
M.I. TUTLUER	Turkey	Overview of the current trends in induced mutagenesis for crop improvement	November 2005
A. AWIBOURI	Iraq	Overview of the current trends in induced mutagenesis for crop improvement	November 2005
W.K. HIRIMBURE-GAMMA	Sri Lanka	Overview of the current trends in induced mutagenesis for crop improvement	November 2005

Fellows/Cost-Free Interns

Name	Country	Area of Training	Period
A. KARIM	Iraq	Induced mutation and related biotechnologies for crop improvement with special emphasis on banana	September 2005 to February 2006
O. OWOSENI	Nigeria	Mutation induction in combination with related biotechnologies for crop improvement with special emphasis on cassava	September 2005 to January 2006
S. GVOZDENOVIC	Serbia & Montenegro	Mutation induction in sunflower (*Helianthus annuus* L.)	October 2005 to January 2006

Consultants

Name	Country	Institute	Purpose	Period
B. FORSTER	United Kingdom	Genome Dynamics Department, Scottish Crop Research Institute, Invergowrie DD2 5DA, Scotland	Optimization of methodologies for the development and detection of mutations at different developmental phases in barley	November 2005

News Sparks

The Third International Conference on Date Palm, Intercontinental Hotel, Abu Dhabi, United Arab Emirates, 19–21 February 2006

The Conference is organized by the United Arab Emirates (UAE) University and the International Society for Horticultural Science. Conference Website: http://datepalm.uaeu.ac.ae

Contacts:

Prof. Abdelouahhab Zaid, P.O. Box 81908, Al Ain, UAE, Tel.: +971 3 7832334, Fax: +971 3 7832472, E-mail: zaid@uaeu.ac.ae

Prof. Vincent Hegarty, P.O. Box 17555, Al Ain, UAE, Tel.: +971 3 7635647, Fax: +971 3 7632384, E-mail: vincent.hegarty@uaeu.ac.ae

The Third International Conference on Legume Genomic and Genetics, Brisbane Convention and Exhibition Centre, Queensland, Australia, 9–13 April 2006

In 2006, the Australian Research Council Centre of Excellence for Integrative Legume Research will host ICLGG3. The theme of the Conference is Genes to Crops, thus reductionist and fundamental science will be reported together with “real world” applications and progress. The format of the meeting will include plenary lectures of broader interest and overview, short research reports, and integrative discussion sessions. Experts from related fields of yeast, Arabidopsis or human genomics will provide possibilities to discuss future directions of the legume genomics field. Experts from the biopharmaceutical and nutritional sciences, representing end users will be invited. Posters will provide a venue of large scale data presentation and a forum for discussion. The meeting will bring together world experts, reporting their findings in both crops as well as model legumes.

For more information, including the current draft programme, visit the Website www.iclgg3.org, which features a diverse range of high profile and challenging speakers.

Contacts:

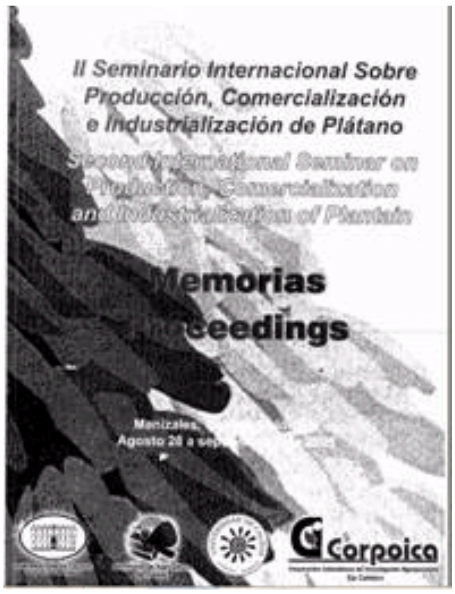
Prof. Peter Gresshoff, Conference Chair and Director, ARC Centre of Excellence for Integrative Legume Research, P.O. Box 104, RBH Post Office QLD 4029, Australia, Tel.: +61 7 3365 3550, Fax: +61 7 3854 1507, E-mail: director.cilr@uq.edu.au

Conference Managers, Tel. +61 7 38541611, Fax: +61 7 3854 1507, E-mail: iclgg3@ozaccom.com.au

Publications

Strategies of the Joint FAO/IAEA Programme for the Use of Induced Mutations for Achieving Sustainable Crop Production in Member States. In: Proceedings of the Second International Seminar on Production, Comercialization and Industrialization of Plantain, Manizales, Colombia, 28 August–2 September 2005

Mba, C., Afza, R., Lagoda, P.J.L. and Dargie, J.



Abstract

The Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture has since its establishment in 1964 assisted Member States of the Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA) in the use of nuclear techniques and related biotechnologies for developing improved strategies for sustainable food security. This is done through the coordination and support of research; provision of technical and advisory services; provision of laboratory support and training; and the collection, analysis and dissemination of information in the areas of crop improvement; soil and water management; insect pest control; animal health and production; and food and environmental safety. These interventions have continued to contribute immensely to sustainable livelihoods in many countries of the world. The scope of our paper is however restricted to a description of our strategies for supporting research and development (R&D) as well as capacity building in developing superior crop varieties. *In vitro* and molecular biology techniques are recognized as tools that lead to efficiency in time and costs in crop improvement programme. This paper also describes our strategies in the provision of services and training in these areas as vehicles for empowering Member States for the sustainable adoption and use of these technologies. Further, the Joint Programme's support of agricultural R&D (including crop biotechnology) in developing Member States under the framework of our Coordination Research Programme (CRP) scheme and the provision of technical inputs into Technical Cooperation Projects (TCPs) are discussed. In addition, we present overviews of the R&D activities in our laboratories in Seibersdorf relating to genetic improvement of banana, cassava and rice, crops we use as platforms for adapting technologies to the circumstances of Member States. It is posited that induced mutations merely expands the options available to plant breeders for developing superior crop varieties through the broadening of the genetic base of available crop germplasm and that this technology is made more efficient when it is transferred to Member States as a comprehensive package including such ancillary tools as *in vitro* and molecular biology techniques.

(2005) ISBN 958–97486-2–9: 281–291

Diploid Ancestors of Triploid Export Banana Cultivars: Molecular Identification of 2n Restitution Gamete Donors and n Gamete Donors

Raboin, L.M., Carreel, F., Noyer, J.L., Baurens, F.C. Horry, J.P., Bakry, F., Tezenas Du Montcel, H., Ganry, J., Lanaud, C. and Lagoda, P.J.L., Molecular Breeding, Springer Science and Business Media B.V. (formerly Kluwer Academic Publishers B.V.), vol. 16(4), pp 333–341.

Abstract

The origin of triploid export banana cultivars was investigated. They all belong to Cavendish and Gros Michel subgroups of triploid clones and have a monospecific Musa acuminata origin. The appearance of these cultivars is thought to be result of hybridization between partially sterile diploid cultivars producing non reduced gametes and fertile diploids producing normal haploid gametes. To trace these diploid ancestors we compared the RFLP patterns, revealed by 36 probe/enzyme combinations, of 176 diploid clones representing the worldwide available variability with that of clones from the Cavendish and Gros Michel subgroups. This led us to the identification of the common putative diploid ancestor of cultivars from Cavendish and Gros Michel subgroups which contributed to triploid cultivar formation through the production of 2n restitution gametes. For cultivars of Gros Michel subgroup we also propose a normal gamete donor that may have complemented the triploid allele set.

(2005) ISSN 1380–3743 (Paper), 1572–9788 (Online)

DOI 10.1007/s11032-005–2452–7

PLEASE COMPLETE THIS REGISTRATION FORM AND SEND IT TO THE PLANT BREEDING AND GENETICS SECTION AT THE FOLLOWING ADDRESS:

Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria
Telefax: (+43-1) 26007, Telephone: (+43-1) 2600

New Crop Variety Developed through Mutation Induction or by Crossing with Induced Mutants

A. **Latin name of species:**

|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

English name: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

B. **Name of new variety (cultivar):**

|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

C. **Year of release from breeder:** |_|_|_|_|

A.1.1. D. **Place and Date of official approval:**

____

E. **Parent variety(ies) - if new variety results from a cross with mutant, indicate which is the mutant:**

		<u>**mutant**</u>
1.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**
2.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**
3.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**

F. **Main improved characters of variety (indicate if character is derived from mutation or not):**

		<u>**mutation derived**</u>
1.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**
2.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**
3.	|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|	**yes / no**

G. **Kind(s) of mutagenic treatment:** |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

H. **Doses(s) and/or concentration(s):** |_|_|_|_|_|_|_|_|_|_|_|

I. **Year of mutagenic treatment:** |_|_|_|_|

J. **How was the variety bred:**

____

K. **Name(s) of breeder(s) and institute(s):**

|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

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Address: |_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

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|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|_|

L. Extent of acceptance by growers:

- **Commercial value:**

_____

- **Hectares of cultivation:**

_____

- **Other:**

_____

M. References (published articles, official documents, etc.):

Name of person contributing this information: _____

THANK YOU FOR YOUR COLLABORATION!

IAEA International Atomic Energy Agency

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